ARCADIS
Infrastructure · Water · Environment · Buildings

Imagine the result

Quarterly Operation, Maintenance and Monitoring Report for the Bethpage Park Soil Gas Containment System

March 2014

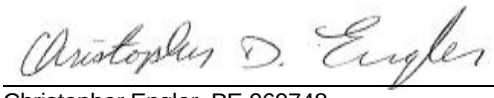
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

NYSDEC ID # 1-30-003A

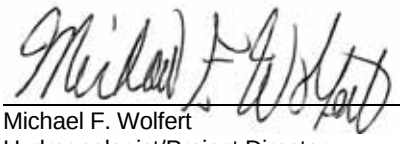
ARCADIS

Albana Bega
Environmental Engineering Specialist

Paul Martorano, PE 088403
Project Engineer



Christopher Engler, PE 069748
Principal Engineer



Michael F. Wolfert
Hydrogeologist/Project Director

Quarterly Operation, Maintenance and Monitoring Report for the Bethpage Park Soil Gas Containment System

March 2014

Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York
NYSDEC ID# 1-30-003A

Prepared for:
Northrop Grumman Systems Corporation

Prepared by:
ARCADIS of New York, Inc.
Two Huntington Quadrangle
Suite 1S10
Melville
New York 11747
Tel 631 249 7600
Fax 631 249 7610

Our Ref.:
NY001496.1214.OMMI4
Date:
May 20, 2014

ARCADIS

Table of Contents

Tables

Figures

Appendices

ARCADIS

Quarterly Operation, Maintenance, and Monitoring Report for the Bethpage Park Soil Gas Containment System
March 2014

Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York
NYSDEC ID # 1-30-003A

1. Introduction

Pursuant to the Administrative Order on Consent (AOC) Index # W1-0018-04-01 (NYSDEC 2005), ARCADIS of New York, Inc. (ARCADIS), on behalf of Northrop Grumman Systems Corporation (Northrop Grumman), has prepared this Operable Unit 3 (OU3) Bethpage Park Soil Gas Containment System (BPSGCS) Quarterly Operation, Maintenance, and Monitoring (OM&M) Report for submittal to the New York State Department of Environmental Conservation (NYSDEC). The present day Bethpage Community Park property (Park), the Grumman Plant 24 Access Road, and McKay Field Access Road (which the NYSDEC has termed the "Former Grumman Settling Ponds Area" and designated as OU3) are referred to herein as the "Site Area". A Site Area location map is provided as Figure 1.

The BPSGCS, (previously referred to as the Soil Gas Interim Remedial Measure), has been operational since February 18, 2008. This quarterly OM&M report summarizes the BPSGCS activities conducted, data collected, system alarms, conclusions, and recommendations for the BPSGCS between January 1 and March 31, 2014 (i.e., the "reporting period"). During this reporting period, the BPSGCS OM&M was conducted in accordance with the NYSDEC-approved OU3 Soil Gas Interim Remedial Measure (IRM) OM&M Manual (ARCADIS 2009) and the NYSDEC-approved Sampling and Analysis Plan (SAP; ARCADIS 2008).

As discussed in the OU3 Site Area Remedial Investigation Report (Site Area RI Report) (ARCADIS 2011a), Northrop Grumman does not take responsibility for certain compounds (e.g., Freon 12 and Freon 22) present in the Site Area. Throughout this report, a distinction is made between the "Project" and "Non-project" volatile organic compounds (VOCs), which are defined as follows:

- "Project VOCs": VOCs that may be related to former Northrop Grumman historical activities. For this report, Project VOCs include 1,1,1-trichloroethane; 1,1-dichloroethane; 1,2-dichloroethane; 1,1-dichloroethene; tetrachloroethene; trichloroethene; vinyl chloride; cis-1,2-dichloroethene; trans-1,2-dichloroethene; benzene; toluene; and total xylenes.

- "Non-project VOCs": VOCs, such as Freon 12 and Freon 22, which are understood to be unrelated to former Northrop Grumman activities but have been detected in the Site Area. As noted in the Site Area RI Report (ARCADIS 2011a), a groundwater sub-plume of Freon 22 has been identified originating from the area

of the Town of Oyster Bay's (Town's) former ice rink. Based on Town information (Zervos 2007), Freon 22 was used by the Town and released to the environment.

2. Bethpage Park Soil Gas Containment System Description and Objectives

Following review and approval of the Soil Gas IRM 95% Design Report and Design Drawings (ARCADIS 2007) by the NYSDEC, the design package was finalized and the BPSGCS constructed. A general site plan that shows the treatment building (which houses the major process equipment, including two 20-horsepower [hp] and one 30 hp regenerative-type depressurization blowers, three 52-gallon moisture separators and associated transfer pumps, one heat exchanger, and one 33-foot tall by 16-inch diameter stack), the 18 depressurization wells, and the 47 induced vacuum monitoring wells is provided as Figure 2. Monitoring well vacuum measurements collected during this reporting period are also provided on Figure 2. A process flow diagram that shows sampling and monitoring locations is provided as Figure 3. A detailed description of the system and a complete set of record drawings are provided in the OM&M Manual (ARCADIS 2009).

The remedial action objectives of the BPSGCS are as follows:

- To mitigate the off-site migration of project VOCs in the on-site soil gas through the implementation of a soil gas containment system installed along the Plant 24 Access Road and McKay Field Access Road, south and west of the Park, respectively.

- To comply with applicable NYSDEC Standards, Criteria, and Guidelines (SCGs).

The compliance objectives of the BPSGCS are as follows:

- To mitigate the off-site migration of soil gas, the system was designed to maintain -0.1 inches of water column (iwc) within a negative pressure curtain established along the Plant 24 Access Road and McKay Field Access Road based on a 12-month rolling average.

- To initially collect and treat vapors until it is demonstrated that all VOCs in the influent (untreated) vapor stream are present at concentrations lower than the NYSDEC Division of Air Resources Guide-1 (DAR-1) Annual Guidance Concentrations (AGCs) on a 12-month rolling average and Short-Term Guidance Concentrations (SGCs) for any given grab sample (NYSDEC 2010b). On

December 29, 2008, NYSDEC approved removal of vapor phase treatment (NYSDEC 2008).

- To collect and transfer collected condensate to the Nassau County Department of Public Works (NCDPW) sanitary sewer, in accordance with the requirements set forth by the NCDPW (NCDPW 2007; NCDPW 2008) or dispose off site at a NYSDEC permitted disposal facility. The sanitary sewer ultimately discharges to the Town of Oyster Bay's Cedar Creek treatment facility.

3. Operation and Maintenance Activities

The BPSGCS operated continuously during the reporting period (greater than 99 percent uptime) with the exception of a brief system shutdown event for routine system maintenance.

Routine monthly O&M activities completed during the reporting period included: inspection of piping, appurtenances, and mechanical equipment for leaks, defects, or other problems; maintenance of equipment in accordance with the manufacturers' specifications; and adjustment of valves and equipment set points to maintain treatment system operating ranges for flow and vacuum. Non-routine O&M activities completed during the reporting period included replacement of the transient voltage surge suppressor module.

4. Monitoring Activities and Results

The following subsections of this report summarize the monitoring activities and results of routine performance and compliance monitoring for the reporting period. The objectives of the performance monitoring program are to demonstrate that the system components are operating in accordance with the manufacturer's specifications and that the operating parameters are within acceptable operating ranges, as provided in Table 3 from the revised OM&M Manual. The purpose of the compliance monitoring program (consisting of the collection of compliance-related induced vacuum readings and effluent vapor/water samples) is to demonstrate that the system is meeting the compliance objectives described in Section 2 of this report.

4.1 Routine Performance Monitoring

The routine quarterly performance monitoring event was completed on March 11, 2014 (hereinafter referred to as the "March monitoring event"). A brief discussion of the monitoring results obtained is provided below.

4.1.1 System Operating Parameters

System operating parameters measured during the March monitoring event are summarized in Tables 1 and 2. Except as summarized below, system operating parameters were consistent with the recommended values in Table 3 from the revised OM&M Manual, which is being submitted under separate cover. During the reporting period, system components were operated in accordance with manufacturers' recommendations. The heat exchanger influent temperature remained lower than the design influent temperature (i.e., 150 degrees Fahrenheit); accordingly, the heat exchanger was not operated during the reporting period.

System operating parameters measured during the March monitoring event that differed from the recommended values in Table 3 of the revised OM&M Manual are as follows:

- Depressurization Well DW-1S had a manifold flow rate and vacuum slightly lower than the minimum of the recommended range.
- Depressurization Well DW-1D had a wellhead vacuum slightly lower than the minimum of the recommended range.
- Depressurization Wells DW-3S and DW-10S had manifold flow rates higher than the maximum of the recommended range.
- Depressurization Wells DW-3S and DW-7D had manifold vacuums slightly higher than the maximum of the recommended range.
- Depressurization Wells DW-4S and DW-5S had manifold vacuums slightly lower than the minimum of the recommended range.
- Depressurization Well DW-7S had a manifold vacuum lower than the minimum of the recommended range.

- Knockout tank KO-200 had an influent vacuum higher than the maximum recommended range.

The observed changes inflow rate, manifold vacuum, and induced vacuum are likely the result of condensate and/or storm water accumulation in the subsurface piping and normal seasonal fluctuation.

Although some system components operated outside of their recommended ranges, the instantaneous induced vacuum at all compliance-related monitoring points was greater than or equal to -0.1 iwc (see Section 4.2.1 of this report). Therefore, no immediate action is warranted. The system operating parameters described above will continue to be evaluated and addressed, if necessary, during the next reporting period. Additional recommendations are provided in Section 6.2 of this report.

4.1.2 Vapor Sample

The total effluent screening level vapor sample (i.e., photoionization detector [PID] reading) measured during the reporting period is provided in Table 1. The screening result was 0.0 parts per million by volume, which is consistent with historical data.

4.2 Routine Compliance Monitoring

Routine compliance monitoring was conducted during the March monitoring event. A brief discussion of the compliance monitoring results is provided below.

4.2.1 System Operating Parameters

Instantaneous vacuum measurements in compliance monitoring wells from the March monitoring event and annual time-weighted rolling averages are summarized in Table 2. March measurements are also shown (in text box format) on Figure 2.

As shown in Table 2, during the March monitoring event, the instantaneous induced vacuum at all compliance related monitoring points was greater than or equal to -0.1 iwc. The annual time-weighted rolling average induced vacuum at all compliance related monitoring points to date is greater than or equal to -0.1 iwc, which indicate that the BPSGCS is operating as designed.

4.2.2 Vapor Sample

A total effluent vapor sample was collected on March 11, 2014. As shown in the laboratory results in Table 3 and Appendix A-1, the total volatile organic compound (TVOC) concentration of 823 micrograms per cubic meter (µg/m^3) was lower than the December 2013 concentration (1,329 µg/m^3) and consistent with historical data. The Project TVOC concentration of 660 µg/m^3 and the Non-project TVOC concentration of 163 µg/m^3 were also lower than the December 2013 concentrations (1,114 µg/m^3 and 215 µg/m^3, respectively) and consistent with historical data.

Benzene was the only environmentally "A" rated compound (as defined in DAR-1 AGC/SGC tables, revised October 18, 2010) detected in the effluent vapor sample during the March monitoring event; the concentration was consistent with historical data.

Twenty tentatively identified compounds (TICs) were also identified by the laboratory (Appendix A-2). The TICs identified were consistent with historical data.

4.2.3 Condensate Samples

A compliance monitoring condensate sample was not required to be collected for laboratory analysis during the reporting period.

5. Air Emissions Model

Effluent vapor laboratory results were compared to the NYSDEC DAR-1 SGCs (Table 3). In addition, effluent vapor laboratory analytical results were compared to a site-specific modeled annual maximum allowable stack concentration (MASC). The annual MASC was calculated during each monitoring event for individual compounds using the output from a USEPA SCREEN3 model in conjunction with the NYSDEC DAR-1 AGCs. A scaling factor was calculated using the SCREEN3 model with site-specific physical layout (e.g., building dimension, stack height, terrain) and operating data (e.g., discharge flow rate, temperature) inputs for each monitoring event. The scaling factor was then used to adjust (scale) the NYSDEC DAR-1 AGC to a site-specific annual MASC. A summary of the instantaneous percent (i.e., not time-weighted) of the site-specific annual MASC for detected compounds is provided in Table 4. A summary of the cumulative annual percent (i.e., time-weighted) of the site-specific MASC for detected compounds is also provided in Table 4. A summary of the model input, outputs, and backup calculations is provided in Appendix B.

The BPSGCS effluent vapor met applicable air discharge criteria based on the following:

- The measured concentrations of individual VOCs in the effluent did not exceed applicable SGCs (Table 3).

- The measured concentration of individual VOCs in the effluent did not exceed applicable instantaneous MASCs, as calculated using the USEPA SCREEN 3 Model (Table 4). Similarly, the time-weighted rolling average for all detected compounds is well below the MASCs.

- One environmentally "A" rated compound was detected in the effluent vapor during the reporting period. Specifically, benzene was detected at 18 µg/m^3. However, the mass emission rate for benzene was 4.69 x 10^{-5} pounds per hour (lbs/hr), which is well below the NYSDEC recommended action level of 0.01 lb/hr. Therefore, no treatment is required.

6. Conclusions and Recommendations

6.1 Conclusions

- The BPSGCS operated continuously during the reporting period with the exception of brief shutdown periods for routine and non-routine maintenance.

- System operating parameters were generally consistent with the recommended values in the OM&M Manual, and system components were operated in accordance with manufacturers' recommendations.

- The March 2014 compliance monitoring results indicate that the system continues to operate as designed. Specifically, BPSGCS maintained -0.1 iwc or greater within all induced vacuum monitoring points based on a 12-month rolling average (from March 28, 2013 through March11, 2014).

- Vapor emissions met applicable guidance and regulatory criteria.

6.2 Recommendations

Based on the information provided herein, ARCADIS makes the following recommendations for the April to June 2014 operating period:

- Continue operation of the BPSGCS.

- Due to the continued accumulation of condensate within several of the depressurization pipelines and the subsequent effect on system performance, assess potential options to prevent and/or minimize condensate accumulation.

- Based on the consistent operation of the BPSGCS since February 2008, we continue to recommend that the current, quarterly reporting frequency be reduced to annual. Consistent with the NYSDEC-approved OU3 Soil Gas IRM OM&M Manual (ARCADIS 2009), an annual report will be prepared to summarize system operation, performance, and monitoring data. The annual report will be prepared and submitted under the supervision of a licensed, professional engineer in the State of New York. Additionally, pertinent data collected for the BPSGCS will be submitted to the NYSDEC as part of the semi-annual progress reports currently completed in accordance with Section III of AOC Index #W1-0018-04-01. Upon receipt of NYSDEC approval of this recommendation, the OU3 BPSGCS OM&M Manual will be updated to reflect this change.

7. References

ARCADIS of New York, Inc. 2007. 95% Design Report, Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York, Site #1-30-003A, September 7, 2007.

ARCADIS of New York, Inc. 2008. 95% Design Report, Appendix C, Sampling and Analysis Plan, Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York, Site #1-30-003A, February 8, 2008.

ARCADIS of New York, Inc. 2009. Operable Unit 3, Operation, Maintenance, and Monitoring Manual, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York, Site #1-30-003A, January 23, 2009.

ARCADIS of New York, Inc. 2011a. Remedial Investigation Report (Site Area). Operable Unit 3 – Former Grumman Settling Ponds, Bethpage, New York. Site #1-30-003A. February 8, 2011.

County of Nassau Department of Public Works (NCDPW). 2007. Letter Regarding Discharge of IRM Condensate Water, Northrop Grumman, OU3 Site, Bethpage, New York. October 16, 2007.

NCDPW. 2008. Letter Regarding Discharge of IRM Condensate Water Northrop, Grumman, OU3 Site, Bethpage, New York. September 17, 2008.

New York State Department of Environmental Conservation (NYSDEC). 2005. Order on Consent Index #WI-0018-04-01, Site # 1-30-003A, July 4, 2005.

NYSDEC. 2007. Approval Letter of 95 Percent Design, Former Grumman Settling Ponds, NYSDEC Nassau County Site No. 1-30-003A OU3 (Bethpage Community Park), September 19, 2007.

NYSDEC. 2008. Letter of Approval For Proposed Modifications, December 12, 2008.

NYSDEC. 2010a. DER-10, Technical Guidance for Site Investigation and Remediation, May 3, 2010.

NYSDEC. 2010b. Division of Air Resources-1 (DAR-1) Guidelines for the Control of Toxic Ambient Air Contaminants dated 1991 and the AGC/SGC Tables dated October 18, 2010.

Zervos, Theodore. 2007. Deposition of Theodore Zervos in the matter Town of Oyster Bay v. Northrop Grumman Systems Corporation et al. Case No. 05-CV-1945 (TCP)(AKT). January 22, 2007.

ARCADIS

Tables

Table 1. Summary of General System Operating Parameters, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.

	Extraction Well DW-7S Parameters			Extraction Well DW-7D Parameters			Extraction Well DW-3S Parameters			Extraction Well DW-3D Parameters			Extraction Well DW-5S Parameters			Extraction Well DW-5D Parameters			Extraction Well DW-6S Parameters			Extraction Well DW-6D Parameters		
Date	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum
	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)
06/19/13	85	-20	-1.5	4.5	-11	-0.41	6.2	-5.0	-0.24	11	-6.0	-0.36	92	-19	-1.5	12	-13	-2.4	83	-17	-1.7	6.2	-5.0	-1.4
09/05/13	86	-20	-1.5	4.0	-13	-0.43	5.0	-8.0	-0.24	10	-7.0	-0.35	95	-19	-1.5	12	-13	-2.3	85	-17	-1.7	6.2	-5.2	-1.3
12/04/13	100	-19	-1.7	5.0	-11	-0.46	5.0	-6.5	-0.22	10	-9.0	-0.39	85	-19	-1.4	12	-13	-2.3	75	-18	-1.8	7.2	-5.5	-1.5
03/11/14	93	-15	-1.7	4.0	-20	-0.38	12	-9.1	-0.40	11	-6.4	-0.44	62	-12	-1.1	11	-12	-2.7	84	-16	-1.8	6.9	-5.4	-1.6

Notes and Abbreviations:

°F	degrees Fahrenheit
DW	depressurization well
ft bmp	feet below measuring point
gal	gallons
Hz	hertz
iwc	inches of water column
NA	not applicable
NM	not measured
ppmv	parts per million by volume
scfm	standard cubic feet per minute
VMWC	vapor monitoring well cluster

1. Total gallons of water accumulated at storage tank ST-510 per quarter.
2. Total effluent air velocity in feet per minute was measured using a hand-held anemometer at the stack effluent location. The total effluent flow rate in scfm was calculated by multiplying the measured air velocity by the pipe area, the ratio of the standard air temperature to the measured air temperature, and the ratio of the measured air pressure to the standard air pressure.
3. Value was remeasured on October 2, 2013 due to an erroneous value of the total effluent flow rate recorded on September 5, 2013.
4. Value was measured on January 27, 2014 due to an erroneous value recorded on December 4, 2013 as a result of a faulty pressure gauge.
5. Value was remeasured on December 6, 2013 due to an erroneous value of the total effluent flow rate recorded on December 4, 2013.
6. Value was remeasured on April 9, 2014 due to an erroneous value recorded on March 11, 2014 as a result of a faulty pressure gauge.

Table 1. Summary of General System Operating Parameters, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.

	Extraction Well DW-1S Parameters			Extraction Well DW-1D Parameters			Extraction Well DW-4S Parameters			Extraction Well DW-4D Parameters			Extraction Well DW-8S Parameters			Extraction Well DW-9S Parameters			Extraction Well DW-2S Parameters			Extraction Well DW-2D Parameters		
Date	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum
	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)
06/19/13	92	-24	-2.1	3.9	-2.6	-1.2	78	-16	-1.6	6.0	-8.5	-0.72	46	-15	-1.4	34	-14	-1.5	33	-22	-1.6	38	-24	-2.5
09/05/13	93	-24	-1.8	1.0	-1.6	-1.2	82	-16	-1.5	4.0	-5.4	-0.59	48	-15	-1.3	34	-14	-1.4	34	-21	-1.6	19	-13	-1.6
12/04/13	80	-23	-2.0	3.2	-2.2	-1.0	70	-16	-1.5	4.0	-5.8	-0.63	47	-17	-1.4	33	-14	-1.3	29	-24	-1.4	21	-14	-1.3
03/11/14	66	-17	-1.6	3.1	-2.0	-0.91	63	-13	-1.3	8.5	-9.1	-0.78	65	-17	-1.9	38	-14	-1.7	27	-23	-1.4	18	-12	-1.4

Notes and Abbreviations:

°F	degrees Fahrenheit
DW	depressurization well
ft bmp	feet below measuring point
gal	gallons
Hz	hertz
iwc	inches of water column
NA	not applicable
NM	not measured
ppmv	parts per million by volume
scfm	standard cubic feet per minute
VMWC	vapor monitoring well cluster

1. Total gallons of water accumulated at storage tank ST-510 per quarter.
2. Total effluent air velocity in feet per minute was measured using a hand-held anemometer at the stack effluent location. The total effluent flow rate in scfm was calculated by multiplying the measured air velocity by the pipe area, the ratio of the standard air temperature to the measured air temperature, and the ratio of the measured air pressure to the standard air pressure.
3. Value was remeasured on October 2, 2013 due to an erroneous value of the total effluent flow rate recorded on September 5, 2013.
4. Value was measured on January 27, 2014 due to an erroneous value recorded on December 4, 2013 as a result of a faulty pressure gauge.
5. Value was remeasured on December 6, 2013 due to an erroneous value of the total effluent flow rate recorded on December 4, 2013.
6. Value was remeasured on April 9, 2014 due to an erroneous value recorded on March 11, 2014 as a result of a faulty pressure gauge.

Table 1. Summary of General System Operating Parameters, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.

	Extraction Well DW-10S Parameters			Extraction Well DW-11S Parameters			Knock Out Tank Parameters Vacuum			Condensate Water Collected [1]	Blower Parameters BL-200			Blower Parameters BL-300			Blower Parameters BL-400			Combined Effluent Parameters				
Date	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Influent KO-200	Influent KO-300	Influent KO-400	Influent ST-510	Influent Vacuum	Effluent Pressure	Blower Speed	Influent Vacuum	Effluent Pressure	Blower Speed	Influent Vacuum	Effluent Pressure	Blower Speed	Total Effluent Flow Rate [2]	Total Effluent PID	Heat Exchanger Influent Temp.	Total Effluent Pressure	Heat Exchanger Effluent Temp.
	(scfm)	(iwc)	(iwc)	(scfm)	(iwc)	(iwc)	(iwc)	(iwc)	(iwc)	(gal)	(iwc)	(iwc)	(Hz)	(iwc)	(iwc)	(Hz)	(iwc)	(iwc)	(Hz)	(scfm)	(ppmv)	(°F)	(iwc)	(°F)
06/19/13	36	-17	-1.9	32	-17	-2.5	-32	0	0	10	-34	3.0	NM	NM	NM	NM	NM	NM	NM	515.01	0.1	104	2.0	96
09/05/13	38	-14	-1.8	34	-21	-2.2	-32	0	0	10	-35	2.5	NM	NM	NM	NM	NM	NM	NM	682.71[3]	0.0	110[3]	2.3[3]	115
12/04/13	30	-14	-1.6	29	-22	-2.6	-40	0	0	0	-45	2.2[4]	NM	NM	NM	NM	NM	NM	NM	719.61[5]	0.0	100[5]	2.0	100
03/11/14	40	-13	-2.2	39	-22	-3.0	-39	0	0	90	-42	2.6[6]	55.53	NM	NM	NA	NM	NM	NA	665.28	0.0	105	3.0	94

Notes and Abbreviations:

°F	degrees Fahrenheit
DW	depressurization well
ft bmp	feet below measuring point
gal	gallons
Hz	hertz
iwc	inches of water column
NA	not applicable
NM	not measured
ppmv	parts per million by volume
scfm	standard cubic feet per minute
VMWC	vapor monitoring well cluster

1. Total gallons of water accumulated at storage tank ST-510 per quarter.
2. Total effluent air velocity in feet per minute was measured using a hand-held anemometer at the stack effluent location. The total effluent flow rate in scfm was calculated by multiplying the measured air velocity by the pipe area, the ratio of the standard air temperature to the measured air temperature, and the ratio of the measured air pressure to the standard air pressure.
3. Value was remeasured on October 2, 2013 due to an erroneous value of the total effluent flow rate recorded on September 5, 2013.
4. Value was measured on January 27, 2014 due to an erroneous value recorded on December 4, 2013 as a result of a faulty pressure gauge.
5. Value was remeasured on December 6, 2013 due to an erroneous value of the total effluent flow rate recorded on December 4, 2013.
6. Value was remeasured on April 9, 2014 due to an erroneous value recorded on March 11, 2014 as a result of a faulty pressure gauge.

Table 2. Summary of Induced Vacuum Readings at Compliance Monitoring Points, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York. [1,2]

Well ID:	DW-7S		DW-7D	DW-3S	DW-3D	DW-5S		DW-5D	DW-1S				DW-1D	DW-4D	DW-8S		DW-2S		DW-2D		DW-11S	
Date	VMWC-14A	VMWC-14B	VMWC-14D	VMWC-11B	VMWC-12D	VMWC-15A	VMWC-15B	VMWC-15D	VMWC-3A	VMWC-3B	VMWC-3C	VMWC-3D	VMWC-16D	VMWC-16A	VMWC-16B	VMWC-7A	VMWC-7B	VMWC-13D	VMWC-17D	VMWC-18A	VMWC-18B
06/19/13	-0.11	-0.17	-0.16	-0.14	-0.13	-0.15	-0.14	-0.15	-0.18	-0.19	-0.17	-0.27	-0.25	-0.17	-0.18	-0.12	-0.13	-0.16	-0.26	-0.10	-0.13
09/05/13	-0.11	-0.14	-0.14	-0.12	-0.12	-0.14	-0.14	-0.15	-0.15	-0.16	-0.18	-0.21[5]	-0.21[5]	-0.11	-0.13	-0.10	-0.11	-0.27	-0.20	-0.10	-0.11
12/04/13	-0.12	-0.19	-0.19	-0.16	-0.15	-0.14	-0.14	-0.15	-0.13	-0.13	-0.14	-0.20	-0.20	-0.14	-0.14	-0.093	-0.098	-0.22[6]	-0.15	-0.10	-0.10
03/11/14	-0.11	-0.19	-0.16	-0.14	-0.15	-0.14	-0.12	-0.12	-0.13	-0.13	-0.13	-0.20	-0.13	-0.18[7]	-0.18[7]	-0.10	-0.12	-0.12[8]	-0.19[8]	-0.13	-0.15
Time Weighted[3] Rolling Average:	-0.11	-0.18	-0.16	-0.14	-0.14	-0.14	-0.13	-0.14	-0.14	-0.15	-0.15	-0.15	-0.16	-0.13	-0.13	-0.10	-0.11	-0.19	-0.20	-0.11	-0.13

Gross Average Compliance Points[4]

03/11/14	-0.14

Notes and Abbreviations:

DW depressurization well
VMWC vapor monitoring well cluster
iwc inches of water column

1. All induced vacuum measurements units in iwc. Values shown have been rounded to two significant figures.
2. Compliance goal is -0.1 iwc of vacuum at all compliance monitoring points, based on a twelve-month rolling average.
3. Time weighted rolling average calculated by summing the products of the instantaneous induced vacuum readings and the number of days between readings for a 12-month monitoring period, and dividing by the total time period between the first and last quarterly induced vacuum readings.
4. Gross average compliance points calculated by summing the induced vacuum values for the noted monitoring event and dividing by the number of readings.
5. Value was remeasured on September 25, 2013 due to an erroneous value recorded on September 5, 2013.
6. Value was remeasured on December 16, 2013 due to an erroneous value recorded on December 4, 2013.
7. Value was measured on March 21, 2014 due to well inaccessability on March 11, 2014.
8. Value was remeasured on March 21, 2014 due to an erroneous value recorded on March 11, 2014.

Table 3. Summary of Total Effluent Vapor Sample Analytical Results, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.[1]

Compound[2] (units in µg/m^3)		Sample ID:	VSP-601	VSP-601	VSP-601	VSP-601
		Sample Date:	6/19/2013	9/5/2013	12/4/2013	3/11/2014
Project VOCs	CAS No.	SGC				
1,1,1-Trichloroethane	71-55-6	9,000	**11**	**14**	**13**	**7.6**
1,1-Dichloroethane	75-34-3	NS	**7.9**	**11**	**11**	**6.9**
1,1-Dichloroethene	75-35-4	380[4]	**2.4**	**2.1**	**1.6**	< 2.0
Benzene	71-43-2	1,300	**2.6**	**15**	< 0.91	**18**
cis-1,2-Dichloroethene	156-59-2	190,000[5]	**470 D**	**490 D**	**500 D**	**320**
Tetrachloroethene	127-18-4	1,000	**17**	**26**	**14**	**7.9**
trans-1,2-Dichloroethene	156-60-5	190,000[5]	**2.9**	**4.8**	**3.3**	< 2.0
Trichloroethylene	79-01-6	14,000	**470 D**	**620 D**	**570 D**	**300**
Vinyl chloride	75-01-4	180,000	**0.97**	**0.85**	**0.92**	< 2.0
Subtotal Project VOCs			**985**	**1,184**	**1,114**	**660**
Non-Project VOCs						
1-Chloro-1,1-difluoroethane (Freon 142b)	75-68-3	NS	**230 D**	**380 D**	**170**	**150**
Bromodichloromethane	75-27-4	NS	< 0.75	**1.2**	< 0.91	< 2.0
Carbon Tetrachloride	56-23-5	NS	**0.78**	**0.96**	< 0.91	< 2.0
Chlorodifluoromethane (Freon 22)	75-45-6	NS	**4.2**	**7.0**	**3.0**	**2.8**
Chloroform	67-66-3	150	**14**	**17**	**38**	**8.0**
Dichlorodifluoromethane (Freon 12)	75-71-8	NS	**2.5**	**3.3**	**2.5**	**2.2**
Trichlorofluoromethane (Freon 11)	75-69-4	9,000	**2.1**	**1.8**	**1.3**	< 2.0
Subtotal Non-Project VOCs			**254**	**411**	**215**	**163**
TVOC[3]			**1,239**	**1,595**	**1,329**	**823**

Notes and abbreviations on last page.

Table 3. Summary of Total Effluent Vapor Sample Analytical Results, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York. (1)

Notes and Abbreviations:

AGC	Allowable Annual Guideline Concentration
Bold	Bold data indicates that the analyte was detected at or above its reporting limit.
CAS No.	Chemical Abstracts Service list number
D	Compound detected at a secondary dilution.
DAR-1	Division of Air Resources-1 Air Guide-1
NS	Guideline concentrations not specified in the NYSDEC DAR-1 AGC/SGC tables, revised October 18, 2010. An interim SGC was not developed for these compounds because they have low toxicity ratings, as specified in the NYSDEC DAR-1 AGC/SGC tables, revised October 18, 2010.
NYSDEC	New York State Department of Environmental Conservation
SGC	Short-term Guideline Concentrations
TVOC	total volatile organic compounds
USEPA	U.S. Environmental Protection Agency
µg/m^3	micrograms per cubic meter

1. Samples were collected by operation and maintenance personnel on the dates shown and submitted to ALS Environmental, Simi Valley, CA for volatile organic compound analyses using USEPA Method TO-15 modified in accordance with the project Sampling and Analysis Plan (ARCADIS 2008). Data presented in this table corresponds to the past year of system operation.
2. Table summarizes detected compounds only.
3. TVOC determined by summing individual detections and rounding to the nearest whole number.
4. An SGC was not provided in the DAR-1 AGC/SGC Tables, revised October 18, 2010. An interim SGC was developed based on guidance provided in Section IV.A.2.b.1 of the New York State DAR-1 Guidelines for the Control of Toxic Ambient Air Contaminants, 1991 edition. Specifically for 1,1- dichloroethene, which is not defined as a high-toxicity compound, the Interim SGC = (smaller of Time Weighted Average [TWA] - Threshold Limit Value or TWA - Recommended Exposure Limit)/4.2. or 1,600 µg/m^3 / 4.2 = approximately 380 µg/m^3. An interim SGC was developed for this compound because it has a moderate toxicity rating, as specified in the DAR-1 AGC/SGC Tables, revised October 18, 2010.
5. An SGC was not provided in the DAR-1 AGC/SGC Tables, revised October 18, 2010. An interim SGC was developed based on guidance provided in Section IV.A.2.b.1 of the New York State DAR-1 Guidelines for the Control of Toxic Ambient Air Contaminants, 1991 edition. Specifically for cis-1,2 dichloroethene and trans-1,2 dichloroethene, which are not defined as a high-toxicity compounds, the interim SGC = (smaller of Time Weighted Average [TWA] - Threshold Limit Value or TWA - Recommended Exposure Limit)/4.2 or 790,000 µg/m^3 / 4.2 = approximately 190,000 µg/m^3. An interim SGC was developed for these compounds because they have moderate toxicity ratings, as specified in the DAR-1 AGC/SGC Tables, revised October 18, 2010.

Table 4. Summary of Air Emissions Model Output, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.

Compound[1]	AGC[2] ($\mu g/m^3$)	Percent of MASC Per Event[3]				Cumulative % MASC[4]
		6/19/2013	9/5/2013	12/4/2013	3/11/2014	
1,1,1-Trichloroethane	5,000	0.0%	0.0%	0.0%	0.0%	0.0%
1,1-Dichloroethane	0.63	0.036%	0.054%	0.052%	0.032%	0.043%
1,1-Dichloroethene	70	0.0%	0.0%	0.0%	0.0%	0.0%
1-Chloro-1,1-difluoroethane (Freon 142b)	50,000	0.0%	0.0%	0.0%	0.0%	0.0%
Benzene	0.13	0.058%	0.36%	0.0%	0.40%	0.21%
Bromodichloromethane	70	0.0%	0.0%	0.0%	0.0%	0.0%
Carbon Tetrachloride	0.17	0.034%	0.044%	0.0%	0.0%	0.018%
Chlorodifluoromethane (Freon 22)	50,000	0.0%	0.0%	0.0%	0.0%	0.0%
Chloroform	0.043	0.94%	1.2%	2.6%	0.54%	1.3%
cis-1,2-Dichloroethene	63	0.022%	0.024%	0.024%	0.015%	0.021%
Dichlorodifluoromethane (Freon 12)	12,000	0.0%	0.0%	0.0%	0.0%	0.0%
Tetrachloroethene	1.0	0.049%	0.080%	0.042%	0.023%	0.047%
trans-1,2-Dichloroethene	63	0.0%	0.0%	0.0%	0.0%	0.0%
Trichloroethylene	0.5	2.7%	3.8%	3.4%	1.7%	2.9%
Trichlorofluoromethane (Freon 11)	5,000	0.0%	0.0%	0.0%	0.0%	0.0%
Vinyl chloride	0.11	0.026%	0.024%	0.025%	0.0%	0.018%

Notes and abbreviations on last page.

Table 4. Summary of Air Emissions Model Output, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York

Notes and Abbreviations:

AGC	Allowable Annual Guideline Concentration
DAR-1	Division of Air Resources-1 Air Guide-1
MASC	Maximum Allowable Stack Concentration
µg/m^3	micrograms per cubic meter
NYSDEC	New York State Department of Environmental Conservation
SGC	Short-term Guideline Concentration
USEPA	U.S. Environmental Protection Agency
%	percent

1. Table summarizes detected compounds only.
2. AGC refers to the compound-specific AGC per the NYSDEC DAR-1 AGC/SGC tables, revised October 18, 2010. NYSDEC DAR-1 AGCs were scaled using the results of a site-specific USEPA SCREEN 3 model to calculate the annual MASC per monitoring event.
3. Percent of MASC per event was calculated by dividing the actual effluent concentration by the site-specific annual MASC. Detailed calculations are included in Appendix B.
4. Cumulative percent of the MASC was calculated using a time-weighted average of the percent MASC per event. Values shown have been rounded to two significant figures.

ARCADIS

Figures

SOURCE:
USGS 7.5 MIN. AMITYVILLE QUADRANGLE, AMITYVILLE, N.Y., 1994, FREEPORT QUADRANGLE, FREEPORT, N.Y., 1994,
HICKSVILLE QUADRANGLE, HICKSVILLE, N.Y., 1967, PHOTOREVISED 1979, HUNTINGTON, N.Y., 1967, PHOTOREVISED 1979

0 2000' 4000'

SCALE IN FEET

NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE, NEW YORK

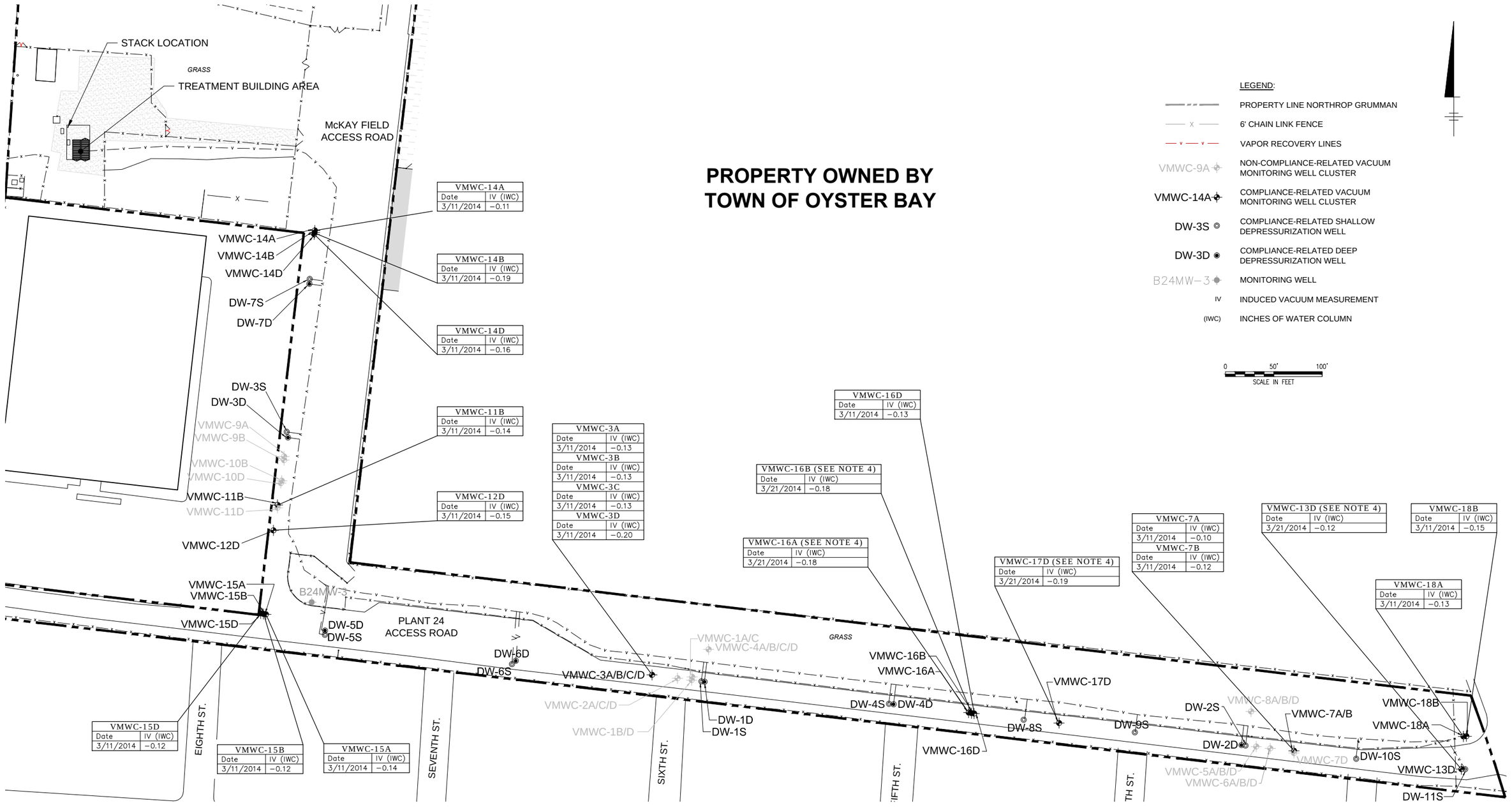
OPERABLE UNIT 3
FORMER GRUMMAN SETTLING PONDS

SITE AREA LOCATION MAP
BETHPAGE PARK SOIL GAS CONTAINMENT SYSTEM

ARCADIS

FIGURE
1

CITY:SYRACUSE-NY DIV/GROUP:ENV DB:A.SANCHEZ LD: PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACTIVE\60014961212\SGS\4\NY1496 F01.dwg LAYOUT: BETHPAGE PARK SAVED: 4/10/2014 11:24 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 4/10/2014 11:39 AM BY: SANCHEZ, ADRIAN
XREFS: IMAGES: PROJECTNAME: ----
AMITYVILLE.TIF
FREEPORT.TIF
HICKSVILLE.TIF
HUNTINGTON.TIF



NOTE:

1. USEPA'S RADON GUIDANCE RECOMMENDS NEGATIVE PRESSURE OF 0.035 INCHES OF WATER FOR THE CONTROL OF SOIL VAPOR (EPA 625/R-93-011, 1993).
2. SYSTEM DESIGN OBJECTIVE IS TO MAINTAIN -0.1 IWC OF INDUCED VACUUM AT ALL COMPLIANCE ONLY MONITORING WELLS ON A 12-MOUNTH ROLLING AVERAGE (ARCADIS 2007).
3. DATA SHOWN HEREIN ARE COLLECTED FROM COMPLIANCE-RELATED MONITORING WELLS ONLY.
4. VALUE WAS REMEASURED ON MARCH 21, 2014 DUE TO WELL INACCESSIBILITY AND ERRONEOUS VALUE RECORDED ON MARCH 11, 2014.

NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE, NEW YORK
OPERABLE UNIT 3
FORMER GRUMMAN SETTLING PONDS

GENERAL SITE PLAN AND MONITORING WELL VACUUM MEASUREMENTS BETHPAGE PARK SOIL GAS CONTAINMENT SYSTEM

ARCADIS

FIGURE
2

CITY:MELVILLE-NY DIV/GROUP:ENVcad DB:ALS LD: PIC: PM:CSG TM: LYR:ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACTIVE\NY001496\12\2SGS\4\NY1496 F02.dwg LAYOUT: 2 SAVED: 4/17/2014 9:58 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: PDF 11X17 PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/17/2014 10:57 AM BY: SANCHEZ, ADRIAN
XREFS: IMAGES: PROJECTNAME: NY001464.0909.00001
Xref_IRMsysItems
Xref_OnSite

DISCHARGE TO ATMOSPHERE

DISCHARGE TO ATMOSPHERE

VSP-602

V-27

TEMPORARY VAPOR PHASE GAC VP-600 (REMOVED FROM OPERATION DECEMBER 2008)

AMBIENT AIR OUTLET

TI 602

TT 602

HEAT EXCHANGER HX-600

ON STANDBY

AMBIENT AIR INLET

PIT 601

PI 601

FE

TI 601

V-26

VSP-601

VSP-201

FE

PI 201

BLOWER BL-200

VI 202

VIT 202

VSP-301

FE

PI 301

BLOWER BL-300 ON STANDBY

VI 302

VIT 302

VSP-401

FE

PI 401

BLOWER BL-400 ON STANDBY

VI 402

VIT 402

WSP-510

SG 510

STORAGE TANK ST-510

VENT

AIR FILTER AF-200

KNOCK OUT TANK KO-200

SG 200

WSP-210

VI 201

RECIRCULATION LINE (TYP. OF 3)

FE 210

FQI 210

TRANSFER PUMP TP-210

AIR FILTER AF-300

KNOCK OUT TANK KO-300

SG 300

WSP-310

VI 301

FE 310

FQI 310

TRANSFER PUMP TP-310

AIR FILTER AF-400

KNOCK OUT TANK KO-400

SG 400

WSP-410

VI 401

FE 410

FQI 410

TRANSFER PUMP TP-410

V-24

V-19

V-21

V-25

V-22

V-20

V-23

LIMIT OF TREATMENT BUILDING 2

LIMIT OF TREATMENT BUILDING 1

V-1 VI 119 VSP-101 FI 101 FE — FROM DW-7D — VI 101

V-2 VI 120 VSP-102 FI 102 FE — FROM DW-3D

V-3 VI 121 VSP-103 FI 103 FE — FROM DW-5D

V-4 VI 122 VSP-104 FI 104 FE — FROM DW-6D

V-5 VI 123 VSP-105 FI 105 FE — FROM DW-1D

V-6 VI 124 VSP-106 FI 106 FE — FROM DW-4D

V-7 VI 125 VSP-107 FI 107 FE — FROM DW-2D

DEPRESSURIZATION WELL (TYPICAL OF 7 DEEP)

V-8 VI 126 VSP-108 FI 108 FE — FROM DW-11S — VI 108

V-9 VI 127 VSP-109 FI 109 FE — FROM DW-10S

V-10 VI 128 VSP-110 FI 110 FE — FROM DW-2S

V-11 VI 129 VSP-111 FI 111 FE — FROM DW-9S

DEPRESSURIZATION WELL (TYPICAL OF 11 SHALLOW)

V-12 VI 130 VSP-112 FI 112 FE — FROM DW-8S

V-13 VI 131 VSP-113 FI 113 FE — FROM DW-4S

V-14 VI 132 VSP-114 FI 114 FE — FROM DW-1S

V-15 VI 133 VSP-115 FI 115 FE — FROM DW-6S

V-16 VI 134 VSP-116 FI 116 FE — FROM DW-5S

V-17 VI 135 VSP-117 FI 117 FE — FROM DW-3S

V-18 VI 136 VSP-118 FI 118 FE — FROM DW-7S

LEGEND:

- CONDENSATE LINE
- LIMITS OF TREATMENT BUILDING
- PROCESS VAPOR LINE
- BALL VALVE (NORMALLY OPEN)
- BALL VALVE (NORMALLY CLOSED)
- BUTTERFLY VALVE (NORMALLY OPEN)
- BUTTERFLY VALVE (NORMALLY CLOSED)
- CHECK VALVE
- UNION
- SAMPLE PORT/DRAIN
- REDUCER
- FERNCO
- FLEXIBLE HOSE
- FLANGE
- FE — FLOW ELEMENT ACCESS
- VI 108 — 1/4" BARB INDUCED VACUUM MONITORING CONNECTION
- INLINE INSTRUMENT
- ISOLATED INSTRUMENT CONNECTED TO PROCESS LINE
- INSTRUMENT CONNECTED TO PROCESS LINE

FE	FLOW MONITORING ELEMENT
FI	FLOW RATE INDICATOR
FQI	FLOW TOTALIZER INDICATOR
PI	PRESSURE INDICATOR
PIT	PRESSURE INDICATING TRANSMITTER
SG	SIGHT GLASS
TT	TEMPERATURE TRANSMITTER
VI	VACUUM INDICATOR
VIT	VACUUM INDICATING TRANSMITTER
VSP	VAPOR SAMPLE POINT
WSP	WATER SAMPLE POINT

NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE, NEW YORK
OPERABLE UNIT 3
FORMER GRUMMAN SETTLING PONDS

PROCESS FLOW DIAGRAM BETHPAGE PARK SOIL GAS CONTAINMENT SYSTEM

ARCADIS

FIGURE
3

ARCADIS

Appendix A

Vapor Sample Analytical Results Including Tentatively Identified Compounds

Appendix A-1. Total Effluent Vapor Sample Analytical Results, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York. [1]

Compound (units in µg/m^3)	CAS No.	Sample ID: VSP-601 Sample Date: 3/11/2014
1,1,1-Trichloroethane	71-55-6	**7.6**
1,1,2,2-Tetrachloroethane	79-34-5	< 2.0
1,1,2-Trichloroethane	79-00-5	< 2.0
1,1-Dichloroethane	75-34-3	**6.9**
1,1-Dichloroethene	75-35-4	< 2.0
1,2-Dichloroethane	107-06-2	< 2.0
1,2-Dichloropropane	78-87-5	< 2.0
1,3-Butadiene	106-99-0	< 2.0
1-Chloro-1,1-difluoroethane (Freon 142b)	75-68-3	**150**
2-Butanone	78-93-3	< 20
2-Hexanone	591-78-6	< 2.0
4-Methyl-2-Pentanone	108-10-1	< 2.0
Acetone	67-64-1	< 20
Benzene	71-43-2	**18**
Bromodichloromethane	75-27-4	< 2.0
Bromoform	75-25-2	< 2.0
Bromomethane	74-83-9	< 2.0
Carbon Disulfide	75-15-0	< 20
Carbon Tetrachloride	56-23-5	< 2.0
Chlorobenzene	108-90-7	< 2.0
Chlorodibromomethane	124-48-1	< 2.0
Chlorodifluoromethane (Freon 22)	75-45-6	**2.8**
Chloroethane	75-00-3	< 2.0
Chloroform	67-66-3	**8.0**
Chloromethane	74-87-3	< 2.0
cis-1,2-Dichloroethene	156-59-2	**320**
cis-1,3-Dichloropropene	10061-01-5	< 2.0
Ethylbenzene	100-41-4	< 2.0
Dichlorodifluoromethane (Freon 12)	75-71-8	**2.2**
Methyl Tert-Butyl Ether	1634-04-4	< 2.0
Methylene Chloride	75-09-2	< 2.0
Styrene	100-42-5	< 2.0
Tetrachloroethene	127-18-4	**7.9**
Toluene	108-88-3	< 2.0
trans-1,2-Dichloroethene	156-60-5	< 2.0
trans-1,3-Dichloropropene	10061-02-6	< 2.0
Trichloroethylene	79-01-6	**300**
Trichlorofluoromethane (Freon 11)	75-69-4	< 2.0
Trichlorotrifluoroethane (Freon 113)	76-13-1	< 2.0
Vinyl chloride	75-01-4	< 2.0
Xylene-o	95-47-6	< 2.0
Xylenes - m,p	179601-23-1	< 3.9
TVOC[2]		**823**

Notes and abbreviations on last page.

Appendix A-1. Total Effluent Vapor Sample Analytical Results, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York. (1)

Notes and Abbreviations:

Bold	Bold data indicates that the analyte was detected at or above its reporting limit.
CAS No.	Chemical Abstracts Service list number
µg/m^3	micrograms per cubic meter
TVOC	total volatile organic compounds
USEPA	U.S. Environmental Protection Agency

1. Samples were collected by operation and maintenance personnel on the date shown and submitted to ALS Environmental, Simi Valley, CA for volatile organic compound analyses using USEPA Method TO-15 modified in accordance with the project Sampling and Analysis Plan (ARCADIS 2008). Data presented in this table corresponds to January to March 2014.
2. TVOC determined by summing individual detections and rounding to the nearest whole number.

Appendix A-2. Total Effluent Vapor Sample Analytical Results, Tentatively Identified Compounds, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.[1,2,3]

	Sample ID:	VSP-601
	Sample Date:	3/11/2014
	Units:	ppbv
1-Butanol		ND
1-Decene		ND
1-Dodecene		ND
1-Methylnaphthalene		**70 JN**
2-Butoxyethanol		ND
2-Hydroxyproppylmethacrylate		ND
2-Methylnaphthalene		**72 JN**
Acetophenone		**4.6 JN**
alpha-Cumyl Alcohol		**4.0 JN**
alpha-Methylstyrene		ND
Benzaldehyde		ND
Butoxyethoxyethanol		ND
Butylformate		ND
$C_8H_8O_2$ Compound		ND
$C_9H_{10}O$ Compound		**NA**
$C_{11}H_{14}$ Compound		**NA**
$C_{11}H_{16}$ Compound		**NA**
$C_{12}H_{24}$ Compound		**NA**
$C_{13}H_{26}$ Compound		**NA**
Ethyleneglycol monohexylether		ND
Heptylbenzene		**3.7 JN**
Hexamethylcyclotrisiloxane		ND
Isobutane		ND
Isooctane		ND
Methyl Methacrylate		ND
n-Butanal		ND
n-Dodecane and Unidentified Compound		**NA**
n-Tetradecane		**22 JN**
n-Tridecane		**16 JN**
Phenol		ND
Propylene Glycol		ND
Substituted 1H-Indene[4]		**NA**
Substituted 1H-Indene[4]		**NA**
Substituted Tetrahydronaphthalene[4]		**NA**
Substituted Tetrahydronaphthalene[4]		**NA**
Substituted Tetrahydronaphthalene and $C_{13}H_{12}$ Compound		**NA**
Tetradecene isomer		**65 JN**
Unidentified Compound		**NA**

Notes and abbreviations on last page.

Appendix A-2. Total Effluent Vapor Sample Analytical Results, Tentatively Identified Compounds, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.[1,2,3]

Notes and Abbreviations:

Bold	Bold data indicates that the analyte was detected.
GC/MS	Gas chromotography/mass spectrometry
JN	Compound tentatively identified, concentration is estimated.
NA	Unidentified compound detected but estimated concentration cannot be calculated.
ND	Unidentified compound detected historically, but not detected during this reporting period.
ppbv	parts per billion by volume
USEPA	U.S. Environmental Protection Agency

1. Samples were collected by operation and maintenance personnel on the dates shown and submitted to ALS Environmental, Simi Valley, CA for volatile organic compound analyses using USEPA Method TO-15 modified in accordance with the project Sampling and Analysis Plan (ARCADIS 2008). Data presented in this table corresponds to January to March 2014.
2. Tentatively identified compounds are identified based on review of mass spectrometry results via a comprehensive library search of all organic compounds.
3. All results are estimated.
4. Compounds eluded at different GC/MS retention times.

ARCADIS

Appendix B

Summary of Air Modeling Calculations

Table B-1. Summary of SCREEN3 Model Input and Outputs, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.

Parameters	Date Sampled:	6/19/2013	9/5/2013	12/4/2013	3/11/2014
SCREEN3 Model Input					
Source Type		Point	Point	Point	Point
Emission Rate (g/s)		1	1	1	1
Stack Height (ft)		33	33	33	33
Stack Height (m)		10.1	10.1	10.1	10.1
Stack Inside Diameter (m)		0.41	0.41	0.41	0.41
Air Flow Rate (scfm)[(1)]		515	683 [(9)]	720 [(11)]	665
Air Flow Rate (acfm @ stack temp)[(2)]		548	741	760	695
Stack Gas Exit Temperature (K)[(1)]		313	319 [(10)]	311	308
Ambient Air Temperature (K)[(3)]		292	288	277	276
Receptor Height (m)[(4)]		1.5	1.5	1.5	1.5
Urban/Rural		Urban	Urban	Urban	Urban
Building Height (m)		2.4	2.4	2.4	2.4
Min Horizontal Bldg Dim (m)		4.9	4.9	4.9	4.9
Max Horizontal Bldg Dim (m)		5.0	5.0	5.0	5.0
Consider Bldg Downwash?		Yes	Yes	Yes	Yes
Simple/Complex Terrain Above Stack		Simple	Simple	Simple	Simple
Simple/Complex Terrain Above Stack Base		Simple	Simple	Simple	Simple
Meteorology		Full	Full	Full	Full
Automated Distances Array		Yes	Yes	Yes	Yes
Terrain Height Above Stack Base		0	0	0	0
SCREEN3 Model Output					
1-HR Max Concentration at Receptor Height ($\mu g/m^3$)[(5)]		1,402	1,104	1,036	1,103
Annualization Factor[(6)]		0.08	0.08	0.08	0.08
Average Annual Concentration at Receptor Height ($\mu g/m^3$)[(7)]		112.2	88.3	82.9	88.2
Distance To Max Concentration (m)[(8)]		43	49	50	49

Notes and abbreviations on last page.

Table B-1. Summary of SCREEN3 Model Input and Outputs, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.

Notes and Abbreviations:

acfm	actual cubic feet per minute
ft	feet
g/s	grams per second
°K	degrees Kelvin
m	meter
scfm	standard cubic feet per minute
$\mu g/m^3$	micrograms per cubic meter
USEPA	U.S. Environmental Protection Agency

1. The stack air flow rate (in scfm) and exit temperature were measured using a handheld thermo-anemometer. Values were measured at the stack effluent location.
2. The stack air flow rate at the stack temperature (in acfm) was calculated by dividing the stack air flow rate in scfm by the ratio of the standard temperature to the actual stack gas exit temperature.
3. The ambient temperature was recorded from the weather.newday.com website for Islip, New York. The mean actual temperature from the website was used in model calculation.
4. The receptor height corresponds to the average inhalation level.
5. SCREEN3 calculated constituent concentration at listed conditions at the specified inhalation level.
6. A USEPA time averaging conversion factor of 0.08 was used to convert the 1-hour maximum concentration output to an annual average.
7. Average annual constituent concentration at the receptor height was calculated by multiplying the one hour maximum concentration by the annualization factor.
8. SCREEN3 calculated distance to the 1-hour maximum concentration.
9. The effluent air flow rate was remeasured on October 2, 2013 due to an erroneous value recorded on September 5, 2013.
10. As of September 5, 2013 the stack gas exit temperature was measured at the heat exchanger effluent location.
11. The effluent air flow rate was remeasured on December 6, 2013 due to an erroneous value recorded on December 4, 2013.

Table B-2. Summary of Maximum Allowable Stack Concentration Calculations, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.

Compound	Actual Effluent Concentrations[(1)] (µg/m^3)			
	6/19/2013	9/5/2013	12/4/2013	3/11/2014
1,1,1-Trichloroethane	11	14	13	7.6
1,1-Dichloroethane	7.9	11	11	6.9
1,1-Dichloroethene	2.4	2.1	1.6	0
1-Chloro-1,1-difluoroethane (Freon 142b)	230	380	170	150
Benzene	2.6	15	0	18
Bromodichloromethane	0	1.2	0	0
Carbon tetrachloride	0.78	0.96	0	0
Chlorodifluoromethane (Freon 22)	4.2	7.0	3.0	2.8
Chloroform	14	17	38	8.0
cis-1,2-Dichloroethene	470	490	500	320
Dichlorodifluoromethane (Freon 12)	2.5	3.3	2.5	2.2
Tetrachloroethene	17	26	14	7.9
trans-1,2-Dichloroethene	2.9	4.8	3.3	0
Trichloroethylene	470	620	570	300
Trichlorofluoromethane (Freon 11)	2.1	1.8	1.3	0
Vinyl chloride	0.97	0.85	0.92	0

Notes and abbreviations on last page.

Table B-2. Summary of Maximum Allowable Stack Concentration Calculations, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.

Compound	AGC[2] ($\mu g/m^3$)	Annual MASC[3] ($\mu g/m^3$)			
		6/19/2013	9/5/2013	12/4/2013	3/11/2014
1,1,1-Trichloroethane	5,000	1.7E+08	1.6E+08	1.7E+08	1.7E+08
1,1-Dichloroethane	0.63	2.2E+04	2.0E+04	2.1E+04	2.2E+04
1,1-Dichloroethene	70	2.4E+06	2.3E+06	2.4E+06	2.4E+06
1-Chloro-1,1-difluoroethane (Freon 142b)	50,000	1.7E+09	1.6E+09	1.7E+09	1.7E+09
Benzene	0.13	4.5E+03	4.2E+03	4.4E+03	4.5E+03
Bromodichloromethane	70	2.4E+06	2.3E+06	2.4E+06	2.4E+06
Carbon tetrachloride	0.067	2.3E+03	2.2E+03	2.3E+03	2.3E+03
Chlorodifluoromethane (Freon 22)	50,000	1.7E+09	1.6E+09	1.7E+09	1.7E+09
Chloroform	0.043	1.5E+03	1.4E+03	1.4E+03	1.5E+03
cis-1,2-Dichloroethene	63	2.2E+06	2.0E+06	2.1E+06	2.2E+06
Dichlorodifluoromethane (Freon 12)	12,000	4.1E+08	3.9E+08	4.0E+08	4.1E+08
Tetrachloroethene	1.0	3.4E+04	3.2E+04	3.4E+04	3.5E+04
trans-1,2-Dichloroethene	63	2.2E+06	2.0E+06	2.1E+06	2.2E+06
Trichloroethylene	0.5	1.7E+04	1.6E+04	1.7E+04	1.7E+04
Trichlorofluoromethane (Freon 11)	5,000	1.7E+08	1.6E+08	1.7E+08	1.7E+08
Vinyl chloride	0.11	3.8E+03	3.6E+03	3.7E+03	3.8E+03

Notes and abbreviations on last page.

Table B-2. Summary of Maximum Allowable Stack Concentration Calculations, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.

Compound	Percent of Annual MASC[4]			
	6/19/2013	9/5/2013	12/4/2013	3/11/2014
1,1,1-Trichloroethane	0.0%	0.0%	0.0%	0.0%
1,1-Dichloroethane	0.036%	0.054%	0.052%	0.032%
1,1-Dichloroethene	0.0%	0.0%	0.0%	0.0%
1-Chloro-1,1-difluoroethane (Freon 142b)	0.0%	0.0%	0.0%	0.0%
Benzene	0.058%	0.36%	0.0%	0.40%
Bromodichloromethane	0.0%	0.0%	0.0%	0.0%
Carbon tetrachloride	0.034%	0.044%	0.0%	0.0%
Chlorodifluoromethane (Freon 22)	0.0%	0.0%	0.0%	0.0%
Chloroform	0.94%	1.2%	2.6%	0.54%
cis-1,2-Dichloroethene	0.022%	0.024%	0.024%	0.015%
Dichlorodifluoromethane (Freon 12)	0.0%	0.0%	0.0%	0.0%
Tetrachloroethene	0.049%	0.080%	0.042%	0.023%
trans-1,2-Dichloroethene	0.0%	0.0%	0.0%	0.0%
Trichloroethylene	2.7%	3.8%	3.4%	1.7%
Trichlorofluoromethane (Freon 11)	0.0%	0.0%	0.0%	0.0%
Vinyl chloride	0.026%	0.024%	0.025%	0.0%

Notes and abbreviations on last page.

Table B-2. Summary of Maximum Allowable Stack Concentration Calculations, Northrop Grumman Operable Unit 3, Bethpage Park Soil Gas Containment System, Former Grumman Settling Ponds, Bethpage, New York.

Notes and Abbreviations:

AGC	Allowable Annual Guideline Concentration
DAR-1	Division of Air Resources-1 Air Guide-1
MASC	Maximum Allowable Stack Concentration
µg/m^3	micrograms per cubic meter
NYSDEC	New York State Department of Environmental Conservation
SGC	Short-term Guideline Concentration
%	percent

1. Actual effluent concentrations are analytical results from air samples collected on the dates shown. Data in this table corresponds to the past year of system operation. Table summarizes detected compounds only.
2. AGC refers to the compound-specific AGC per the NYSDEC DAR-1 AGC/SGC tables, revised October 18, 2010.
3. Annual MASC was calculated by dividing the product of the AGC of a compound and the ratio of the SCREEN3 gas emission rate and the SCREEN 3 average annual concentration at receptor height by the air flow rate at the stack temperature and multiplying by the appropriate conversion factors.
4. Percent of MASC was calculated by dividing the actual effluent concentration by the MASC for a given monitoring event.